

Revision of the genus *Squamigera* (Insecta: Zygentoma: Nicoletiidae) with descriptions of two new species

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Abstract.—The genus *Squamigera* was described in 1999 from a single male. Understanding of the genus was therefore limited. After several unsuccessful expeditions, new material has finally been collected from the same cave. New material of related *Squamigera* species was also found while reviewing museum collections. From these specimens two new species, *S. cumcalcaris* and *S. jaureguii*, are described, and a better description of the diagnostic characters of the genus is provided.

In 1988, a single male thysanuran was collected by R. Espinasa-Closas in a Mexican cave (Cueva de las Pozas Azules). The specimen is unique in many ways. Measuring 22 mm, it is one of the largest specimens in the family Nicoletiidae, but more diagnostically, it has spines on the cerci and scales cover its body and head. All other members of the subfamily Cubacubaninae lack this combination. Despite many subsequent visits to the same locality, no other specimens were found. Eleven years after the original discovery, the specimen was described (Espinasa 1999a) and the new nicoletioid genus *Squamigera*, was established. By necessity, the description of *Squamigera* lacked a description of the female morphology or of postembryonic development. Comparison of the genus with other members of the subfamily was difficult because it was unclear which characters were unique to the specimen (species variation) and which characters had phylogenetic/taxonomic value.

Fortunately, the situation has changed. A revision of the nicoletioid collection of the American Museum of Natural History provided a single female from a surface locality collected in 1976 by Reddell and Grubs. Also, the Sbordoni collection of cavernicole organisms from Chiapas provided two

males and one female from two caves. And finally, an additional male has been collected from the type locality. This male is considerably larger than any other American nicoletioid described.

From these specimens, two new species are described and a revision of the taxonomic characters for the genus is provided.

Materials and Methods

The live specimen was found crawling on the cave wall and was preserved in 96% ethanol. Dissections were made with a stereo microscope and the body parts were mounted in fixed preparations with Hoyer's solution. The female and juvenile male from Chiapas, and the new Pozas Azules specimen were not dissected. All illustrations were made with aid of a camera lucida attached to a compound microscope. The types were deposited in the Zygentoma collection of the American Museum of Natural History.

Squamigera Espinasa, 1999

Diagnosis (amended).—A member of the subfamily Cubacubaninae with mucronate to emarginate scales with smooth to serrate borders. Cerci of males with modified

spines. Parameres without a cleft on the apex.

Description (amended).—Body proportions normal to robust. Head, thorax, abdomen, and proximal articles of legs with scales and setae. Distal articles of legs, mouthparts and abdominal stylets only with setae. Scales numerous and multiradiate, their form mucronate to emarginated, with smooth to highly serrated borders.

Pedicellus of adult males with unicellular glands and apparently with a spur on its base. Mouthparts not specialized. Mandibles strongly sclerotized apically with usual teeth. Galea apically with several sensory pegs. Lacinia heavily sclerotized distally. First process of lacinia pectinate. Labium without prominent lateral lobes.

Tarsi with four articles. Praetarsi with three simple claws. Middle claw glabrous, slender and smaller than lateral claws. Urosterna II–VII subdivided into coxites and sternite. Urosterna VIII and IX of male entire. Middle portion of sternites with 1 + 1 sublateral macrochaetae at hind borders, as well as 1 + 1 near suture at about middle of segment. Coxites on segments II–IX with stylets. Eversible vesicles on segments II–VI, pseudovesicles on VII. Urosterna III of adult males sometimes with modified coxites. Urosterna IV apparently without articulated submedian appendages. Urosterna VIII with a wide and not too deep posterior emargination. Posterior projections acute to slightly round, pointing slightly outward. Tergum X very protruding, almost straight on posterior border. Posterior angles with several subequal macrochaetae.

Point of insertion of parameres relatively deep and with modified setae on internal face of coxal processes. Parameres with specialized setae on apex, but without a cleft or other modifications. Stylets IX apparently without spines. Opening of penis longitudinal. Cerci of male with modified spines. Median filament with or without spines. Females with a subgenital plate and gonapophyses of adult females apparently with numerous articles.

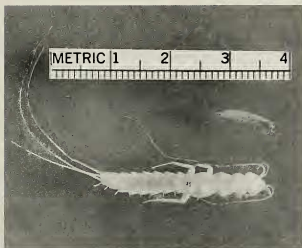


Fig. 1. *Squamigera latebricola*, male topotype (larger individual, dorsal view) and *Squamigera* sp., juvenile male (smaller individual, ventral view). Comparison of body proportions to illustrate the large size of *S. latebricola*.

Type species.—*Squamigera latebricola* (Fig. 1).

Distribution.—All specimens to date come from south-central Mexico. It is currently unknown but likely that members of the genus occur in South America and the Antillean islands. Their distribution is probably restricted to the neotropics.

Remarks.—Several amendments were made to the original description of the genus: 1. Body proportions are not always robust. 2. Scales are not only slightly serrated, but can be highly serrated. 3. Size of spur on male pedicellus can be variable. 4. Urosterna II subdivided into coxites and sternite. In the fixed preparation of the holotype it was unclear if the urosterna was divided. 5. Urosterna III of adult males can have modified protuberances similar to those found in some *Cubacubana* (Espinasa 1991) and *Prosthecina* (Espinasa 2000). 6. Number of macrochaetae in posterior angles of tergum X can be variable. 7. Point of insertion of parameres relatively deep and with modified setae on internal face of coxal processes. 8. Parameres without a cleft. In the fixed preparation of the holotype, the parameres were broken as an artifact of the preparation, giving the impression of a cleft (The

cleft/break was not represented in the original figures, it was only mentioned in the text). 9. Central filament sometimes with spines. 10. Females with a subgenital plate and gonapophyses of adult females apparently with numerous articles. There were no female samples available when the original description was made.

Squamigera belongs to a group of nicoletioid genera, the Cubacubaninae (Mendes 1988), characterized by subdivided urosterna II–VII and fused coxites VIII and IX of males. *Squamigera* is distinguished from almost all genera of this subfamily by having scales. It differs from *Texoreddellia* (Wygodzinsky 1973), the only other genus with scales, by the morphology of scales (in *Texoreddellia* scales have three pointed borders instead of smooth to serrated borders), and by having scales in the head and modified spines in cerci, which are both absent in *Texoreddellia*.

Squamigera cumcalcaris, new species

Figs. 2A–G, 3A–E

Type material.—"Grotta I Finca S. Anita" cave, Finca S. Anita, Simojovel de Ailende, Chiapas, México. 830 m above sea level. 10/IX/1973 V. Sbordoni col. Male holotype, female paratype.

Description.—Body length 15 mm. Maximum conserved length of antennae 12 mm and of caudal appendages 11 mm. General color: light yellow to white. Morphology of the body as in generic description. Scales similar to Fig. 5B.

Male antennae as in Fig. 2A–B. Pedicellus slightly more than one half as long as basal article. On ventral side with approximately six clusters of unicellular glands arranged in two long rows, surrounded by microchaetae forming a "U" shape. Outside this microchaetae, another two clusters of unicellular glands and a downward pointing robust spine, opposite to an extension of the basal article (Fig. 2B). Base of female antennae simple and pedicellus half as long as basal segment.

Head with approximately 5 + 5 macrochaetae on border of insertion of antennae (Fig. 2A). Mouthpart appendages relatively short. Labial palp as in Fig. 2D. Apical article slightly wider than long and barely longer than penultimate article. Penultimate article with bulge containing macrochaetae. Labium and first article of labial palp with macrochaetae. Maxilla as shown in Fig. 3D. Last article slightly longer than penultimate. Apex of maxillary palp with two conules of similar width and a 3rd minute extra conule similar to Fig. 4G. Two teeth on lacinia. Mandibles chaetotaxy as in Fig. 2C.

Thoracic nota with scales and macrochaetae on lateral borders apart from several setae of varied sizes (Fig. 3B), but no small sclerotized spines on posterior borders. Legs relatively short and stout. Tibia on 2nd leg with five macrochaetae, some of them stout, and approximately 3.5× longer than wide and 1/3 shorter than tarsus (Fig. 2E). Tibia on 3rd leg with five macrochaetae, and approximately 4.5× longer than wide and 1/5 shorter than tarsus (Fig. 2F). Claws relatively short.

Urosterna III and IV of male without modifications in the samples examined. It is currently unknown if more fully adult specimens will develop them. Urosterna VIII posterior projections acute to slightly rounded, subtriangular (Fig. 3A). Urotergite X posterior angles with several long macrochaetae and setae of different sizes. On the borders some prominent scales (Fig. 2G).

Urosterna IX of male similar to some *Anelpistina*; point of insertion of parameres deep and setae slightly more sclerotized on internal face of coxal processes and above insertion of parameres (Fig. 3A). Stylets IX bigger than the others, with 4–5 macrochaetae and an extra subapical pair. In both males and females without spines or other modifications. Other stylets have only three macrochaetae plus the subapical pair.

Penis and parameres as shown in Fig. 3A. Parameres attaining 1/2 of stylets IX. Parameres globular and with a distinct group of microchaetae on the tip. Overall

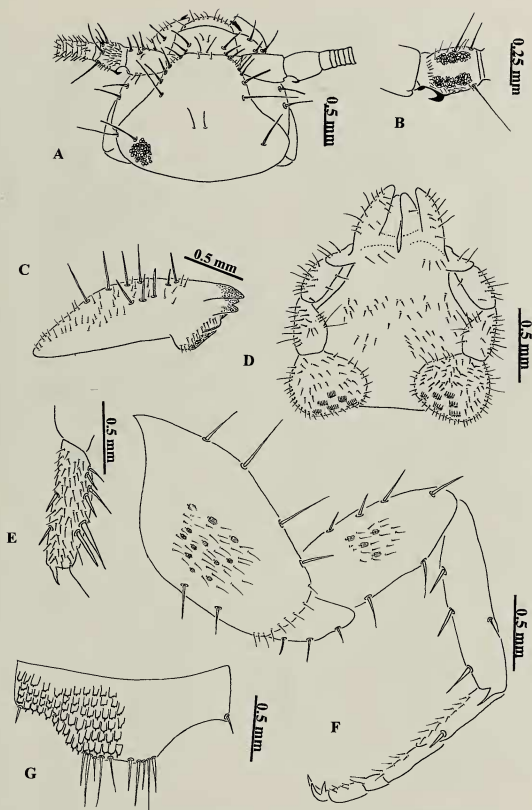


Fig. 2. *Squaligera cumcalcaris*. Male holotype. Scales and microchaetae partially shown; A, Head; B, Pedicellus; C, Mandible; D, Labial palp and labium; E, Tibia of 2nd leg; F, 3rd leg; G, Urotergum X.

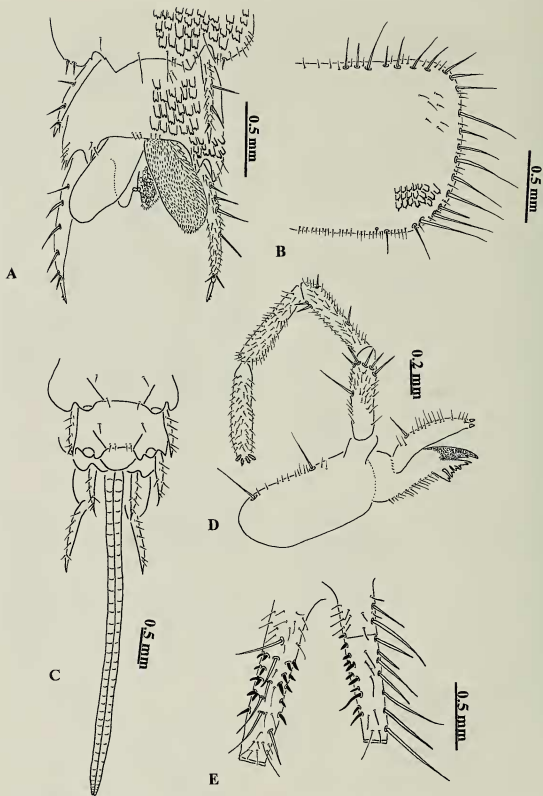


Fig. 3. *Squamigera cumcalcaris*. Male holotype except C, female paratype. Scales and microchaetae partially shown; A, Genital area; B, Thoracic tergum; C, Ovipositor; D, Maxilla; E, Median filament (left) and cercus (right).

appearance similar to some *Prosthecina* (Wygodzinsky 1946). Subgenital plate of female parabolic (Fig. 3C). Ovipositor surpassing apex of stylets IX by thrice the length of stylets (Fig. 3C). Gonapophyses with approximately 38 articles.

Male caudal appendages as in Fig. 3E. Inner side of cerci in males with spines of varied sizes. Some spines arranged even in a double row. The central filament also with spines of subequal size arranged on multiple rows facing both cerci. Female caudal appendages without modifications.

Postembryonic development unknown because of the scarcity of samples. It is assumed that specimens examined are adult based on the development of sexual secondary characters. Comparison to other species within the subfamily indicates that in younger instars we could expect that spines, modifications of antenna, and size of parameres to be reduced in younger males. In females a smaller ovipositor could be expected.

Known range.—Known only from the type locality.

Etymology.—The name is derived from the Latin "cum+calcaris" for with+spur, alluding to the prominent curved spur in the pedicellus of the antennae in males.

Remarks.—*Squamigera cumcalcaris* can be differentiated from all species of subfamily Cubacubaninae by the spines on the central filament. Such spines until now were described only in Nicoletiids in the subfamilies Coletiniinae and Subnicoletiinae (Mendes 1988). Adult males can be further differentiated by the large curved spur oriented toward the base of antennae in the pedicellus, which in *S. latebricola* is reduced to a small spine. Adult females can be differentiated from *S. jaureguii* by a parabolic instead of trapezoidal subgenital plate and by a considerably less subdivided gonapophyses.

Squamigera jaureguii, new species

Figs. 4A–H, 5A–F, 6A–D

Type material.—Puente Actopan, 5 km SE Actopan, Veracruz, Mexico. 25 Dec

1976. J. Reddell and A. Grubbs cols. Female holotype.

Description.—Body length 9.5 mm. Antennae and caudal appendages broken. Maximum conserved length of antennae 4 mm and of caudal appendages 5 mm. Body proportions as in Fig. 4A. General color: light yellow to white. Morphology of the body as in the generic and *S. cumcalcaris* descriptions, unless otherwise stated. Scales as in Figs. 4D and 5B.

Antennae as shown in Fig. 4B. Basal article without projections. Pedicellus slightly less than one half as long as the basal article. Head with approximately 8 + 8 macrochaetae on border of insertion of antennae (Fig. 4C). Labial palp as in Fig. 4E. Maxilla as shown in Fig. 4F–G. Last article $\frac{1}{2}$ longer than penultimate. Apex of maxillary palp with two conules of similar width and a 3rd minute extra conule (Fig. 4G). Mandibles chaetotaxy as in Fig. 4H. Thoracic nota as in fig. 5A. Legs relatively short and stout (Fig. 5C–D). Tibia on 2nd leg with five macrochaetae, some of them stout, and approximately 3.2× longer than wide and $\frac{1}{4}$ shorter than tarsus, and five macrochaetae. Hind leg broken in the specimen. Claws relatively short (Fig. 5E).

Urosterne I and II as in Fig. 5F. Urotergite X posterior angles with 2–3 long macrochaetae and setae of different sizes and on borders some prominent scales (Fig. 6A). Stylets IX bigger than the others, with 5–6 macrochaetae and an extra subapical pair (Fig. 6B). Subgenital plate of female trapezoid, outer border almost straight (Fig. 6B). Ovipositor surpassing apex of stylets IX by thrice the length of stylets (Fig. 6B). Apex as in Fig. 6C. Gonapophyses with approximately 53 articles. Cerci without modifications (Fig. 6D).

Males unknown. Postembryonic development unknown because only a single female individual could be examined. It is assumed that this individual is an adult based on its large ovipositor. Comparison to other species within the subfamily indicates that

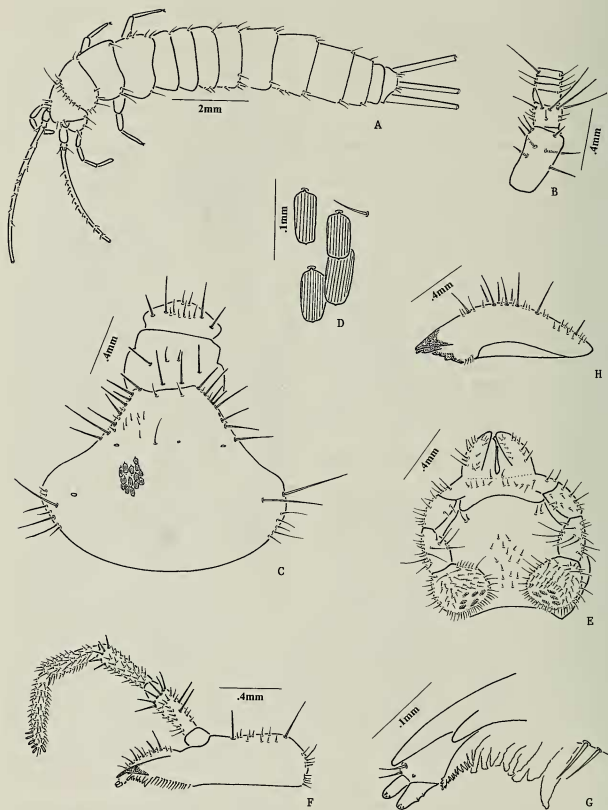


Fig. 4. *Squamigera jauregui*. Female holotype. Scales and microchaetae partially shown. A. Body; B. Basal portion of antennae; C. Head; D. Scales on head; E. Labial palp and labium; F. Maxilla; G. Apical portion of maxilla; H. Mandible.

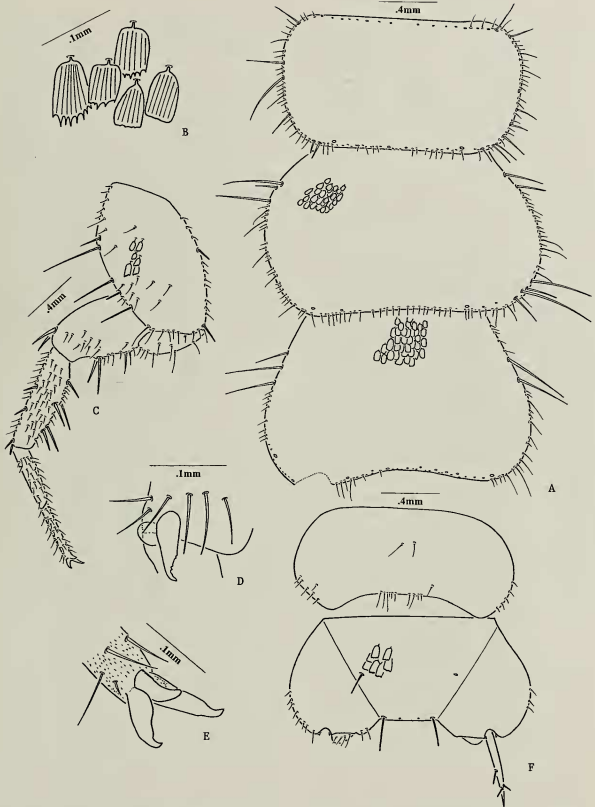


Fig. 5. *Squamigera jaureguii*. Female holotype. Scales and microchaetae partially shown. A, Thoracic tergum; B, scales of urotergum I; C, 2nd leg; D, Apex of 2nd tibia; E, Claws of 2nd leg; F, Urosternum I and II.

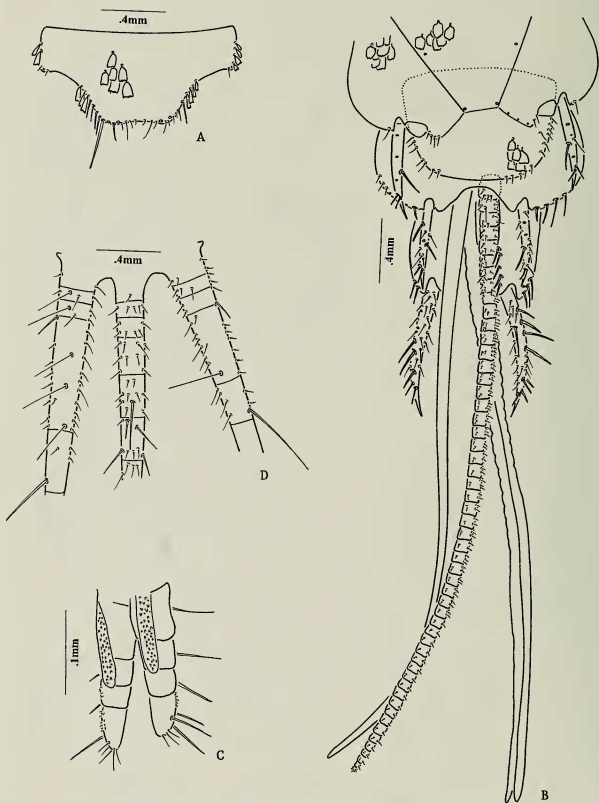


Fig. 6. *Squamigera jauregui*. Female holotype. Scales and microchaetae partially shown. A, Urotergum X; B, Subgenital plate and ovipositor; C, Apex of ovipositor; D, Caudal appendages.

in younger instars we could expect a smaller ovipositor.

Known range.—Known only from the type locality.

Etymology.—This species is dedicated to Sergio Jáuregui to recognize his enthusiastic, long time participation in cave coleleptid collecting and field work.

Remarks.—*Squamigera jaureguii* can be differentiated from other described *Squamigera* by having more macrochaetae on the head at the border of the insertion of antennae, and a shorter body and appendages. Adult females can be differentiated from *S. cumcalcaris* by the trapezoidal instead of parabolic subgenital plate and by a considerably more subdivided gonapophyses. No *S. latebricola* females are available for comparison.

Squamigera latebricola Espinasa
Fig. 7A–G

Topotype.—"Cueva de las Pozas Azules" cave (Espinasa-Pereña 1989), Taxco de Alarcón Municipality, Guerrero State, México, 18°36'40"N, 99°33'25"W. April 2001. L. Espinasa col. Male.

Description.—Body length 29 mm. Maximum conserved length of antennae 29 mm and of caudal appendages 35 mm. Body proportions as in Fig. 1. General color: light yellow to white. Morphology of body similar to *S. cumcalcaris* and *S. jaureguii*, unless otherwise stated. Scales with slightly less serrated borders.

Pedicellus with clusters of unicellular glands and a small spur (Espinasa 1999a; Fig. 1C) instead of long hooked spine of *S. cumcalcaris*. Mouthpart appendages relatively thin and long. Apical article of labial palp barely longer than wide and barely shorter than penultimate (Espinasa 1999a; Fig. 1D). Penultimate article's bulge not too prominent. Maxilla as in Fig. 7D. Last article shorter than penultimate. Apex of maxillary palp with two conules of similar width and a 3rd small extra conule (Fig. 7E).

Thoracic nota with small sclerotized spines on lateral and posterior borders (Espinasa 1999a; Fig. 3A). Legs relatively long (Espinasa 1999a; Fig. 2A). Tibia on 2nd leg with seven thin macrochaetae, and approximately 4.5× longer than wide and 1/3 shorter than tarsus. Tibia on 3rd leg with eight thin macrochaetae, and approximately slightly over 5× longer than wide and 1/4 shorter than tarsus. Trochanter on 3rd leg with a protuberant spine projection (Fig. 7B) which is not present in the smaller sized (22 mm) holotype. Claws of normal size.

Coxites in urosterna III (Fig. 7C) with protuberances similar to those found in some *Cubacubana* (Espinasa 1991) and *Prosthecina* (Espinasa 2000). Urosterna III in smaller holotype also with a slight protuberance (not reported in original description), similar to nascent protuberance found in some immature individuals of the aforementioned *Cubacubana* and *Prosthecina*. Urosterna IV without modifications (Fig. 7A). Urosternum IX as in Fig. 7F. In this specimen the point of insertion of parameres is slightly deeper than in the holotype and closer in appearance to some *Anelpistina* (Espinasa 1999b). Stylets IX with five macrochaetae and an extra subapical pair but otherwise without any other modifications. Penis and parameres as shown in Fig. 7F. Parameres attaining less than 1/2 of stylets IX and curved outward. Cerci as in Fig. 7G. Females unknown.

Postembryonic development only partially understood since only two fairly large male individuals are available, the holotype (22 mm) and this new topotype (29 mm). In the smaller specimen, projections of urosterna III are only starting to develop, spines in cerci are less prominent and trochanter of hind leg has no projection.

Known range.—Known only from the type locality.

Remarks.—Being 3 cm in length (10 cm if antennae and caudal appendages are included), *S. latebricola* can easily be differentiated from all species of the subfamily

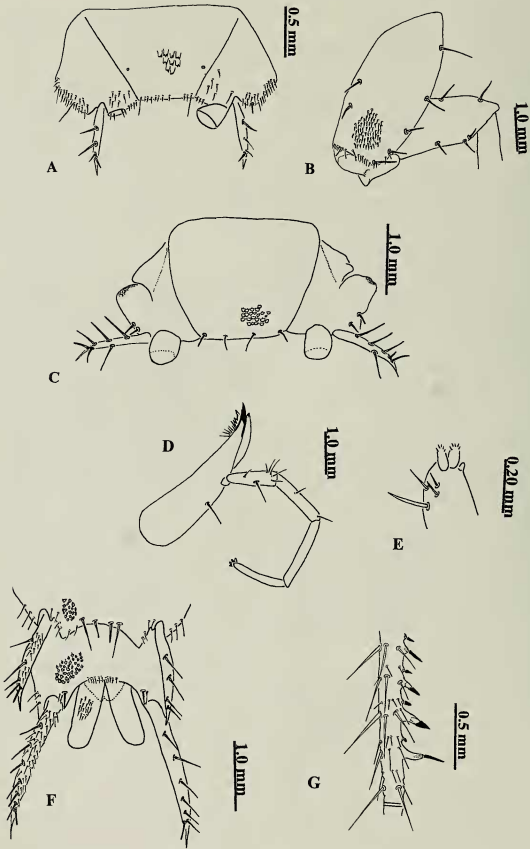


Fig. 7. *Squamigera latebricola*. Male topotype. Scales and microchaetae partially shown. A, Urosternum IV; B, 3rd leg. Notice projection in trochanter (scales not shown); C, Urosternum III; D, Maxilla; E, Apical portion of Maxilla; F, Genital area; G, Spines in cercus.

Cubacubanae by its large size. This is the longest species among the Nicoletiids, which typically measure 1 cm or less. Enlargement of body and appendages is common among cave adapted organisms and it is certainly the case for this species. This species can further be differentiated from *S. cumcalcaris* and *S. jaureguii* by the small sclerotized spines on lateral and posterior borders on thoracic nota (Espinasa 1999a; Figs. 1G and 3A), and by the morphology of its sexual secondary characters.

Squamigera sp.

Fig. 1

Material examined.—"El Chorreadero" cave, Chiapa de Corzo Municipality, Chiapas, México. 650 m above sea level. 10/11-VIII-73. V. Sbordoni col. Male.

Description.—Body length 10 mm. Antenna and caudal appendages broken. Middle filament missing. Scales as in other members of the genus. No apparent spines in pedicellus, sterna III, or cerci. Parameres curved outward, similar to the holotype of *S. latebricola* (Espinasa 1999a, Fig. 2C), but attaining less than $\frac{1}{5}$ of stylets IX. This single individual is probably not a mature adult. Chorreadero cave is visited relatively often by speleologists and hopefully more samples will be available one day for a formal description of this population.

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